Name ____ AP Chemistry

Acid-Base Titrations

Introduction

The technique of titration finds many applications, but is especially useful in the analysis of acidic and basic substances. Titration involves measuring the exact volume of a solution of known concentration that is required to react with a measured volume of a solution of unknown concentration. In titration analyses, there must be some means of knowing when enough titrant has been added to react exactly and completely with the sample being titrated. In an acid/base titration analysis, there should be an abrupt change in pH when the reaction is complete. For example, if the sample being titrated is an acid, then the titrant to be used will be basic (probably sodium hydroxide). When one excess drop of titrant is added (beyond that needed to react with the acidic sample), the solution being titrated will suddenly become basic. There are various natural and synthetic dyes, called indicators, which exist in different colored forms at different pH values. A suitable indicator can be chose that will change color at a pH value consistent with the point at which the titration reaction is complete. The indicator to be used in this experiment is phenolphthalein, which is colorless in acidic solutions, but changes to a pink form at basic pH. With this activity, you will look at a strong acid-strong base and weak acid-strong base titration and determine the concentration of the base in each titration.

Procedure

1) Go to the class website. Click on "Unit VII-Acid-Base Chemistry & Aqueous Equilibrium" on the left sidebar. Scroll to the bottom of webpage and click on the link for "Acid-Base Titration."
2) Choose 'Strong Acid vs. Strong Base' under number 1—Select Type of Reaction and then choose 'Base' under number 2—Fill the Burette with.
3) Click on number 3—Select the Acid and Base. Choose any acid **except** H_2SO_4 (____________) and then choose NaOH for the base.
4) Choose 'phenolphthalein' under number 4—Select the Indicator.
5) Using the slider bar to the right of the burette, add 1 or 2 mL of base at a time to the flask until the solution starts to turn pink. Once it starts to turn pink but quickly fade, add base dropwise until the solution in the flask stays pink. It should be a light pink; if you make it a dark pink, restart.
6) Record the volume of base used: _____________ mL
7) Now calculate the unknown concentration of the base:
   (a) First calculate the moles of acid in the flask using the molarity of acid and volume in liters:

(b) Assuming the endpoint and equivalence are the same, the moles of acid and base are equal. What are the moles of base?

(c) Calculate the molarity of base by dividing the moles of base from part b by the total volume of the base used in L.

8) Input the molarity that you calculated in question 7c under number 6—After Titration, Calculate and Enter Molarity of Base. Click 'OK'.
9) If you are correct, a button entitled 'Graph' will appear to the right of the flask. Click on this button and sketch the graph you see below. Make sure to label your axis appropriately.

10) Click 'Return' at the bottom right corner of the graph and then click 'Reset' in the lower left corner of the simulation.
11) Choose 'Weak Acid vs. Strong Base' under number 1—Select Type of Reaction and then choose 'Base' under number 2—Fill the Burette with.
12) Click on number 3—Select the Acid and Base. Choose CH_3COOH for the acid and then choose NaOH for the base.
13) Choose 'phenolphthalein' under number 4—Select the Indicator.
14) Using the slider bar to the right of the burette, add 1 or 2 mL of base at a time to the flask until the solution starts to turn pink. Once it starts to turn pink but quickly fade, add base dropwise until the solution in the flask stays pink. It should be a light pink; if you make it a dark pink, restart.
15) Record the volume of base used: _____________ mL
16) Now calculate the unknown concentration of the base:
    (a) First calculate the moles of acid in the flask using the molarity of acid and volume in liters:

(b) Assuming the endpoint and equivalence are the same, the moles of acid and base are equal. What are the moles of base?

(c) Calculate the molarity of base by dividing the moles of base from part b by the total volume of the base used in L.

17) Input the molarity that you calculated in question 7c under number 6—After Titration, Calculate and Enter Molarity of Base. Click 'OK'.
18) If you are correct, a button entitled 'Graph' will appear to the right of the flask. Click on this button and sketch the graph you see below. Make sure to label your axis appropriately.

Questions

1) Compare and contrast the two titrations and the titration curves produced.

2) In this activity, we assumed that the endpoint and the equivalence point were equal. Is this actually true? Why or why?

3) How many milliliters of 0.0850 M NaOH are required to titrate the following solutions to their equivalence point:
(a) 40.0 mL of 0.0900 M HNO_3
(b) 35.0 mL of 0.0850 M CH_3COOH